Claims

1. An electroluminescent device comprising in sequence, (i) an anode, (ii) a layer of an electroluminescent material of general formula $(L\alpha)_nM$ where M is a rare earth, lanthanide or an actinide, Lα is an organic complex as specified herein and n is the valence state of M, and (iii) a cathode, in which the layer of an electroluminescent material includes a fluorescent dye.

2. An electroluminescent device as claimed in claim 1 in which the electroluminescent material is of general formula

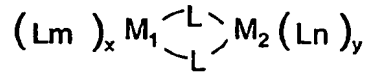
where Lα and Lp are organic ligands, M is a rare earth, transition metal, lanthanide or an actinide and n is the valence state of the metal M, the ligands Lα can be the same or different and there can be a plurality of ligands Lp which can be the same or different where Lα and Lp are as specified herein.

3. An electroluminescent device as claimed in claim 1 in which the electroluminescent material of general formula $(L\alpha)_nM_1M_2$ where M_1 is the same as M above, M_2 is a non rare earth metal, Lα is as specified herein and n is the combined valence state of M_1 and M_2.

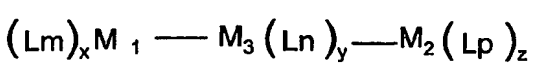
4. An electroluminescent device as claimed in claim 1 or 2 in which the complex also comprises one or more neutral ligands Lp and the complex has the general formula $(L\alpha)_n M_1 M_2 (Lp)$.

5. An electroluminescent device as claimed in claim 1 in which the electroluminescent material is a binuclear, trinuclear and polynuclear organometallic

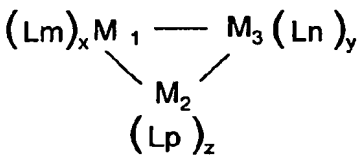
complexes of formula $(Lm)_x M_1 \leftarrow M_2(Ln)_y$ or



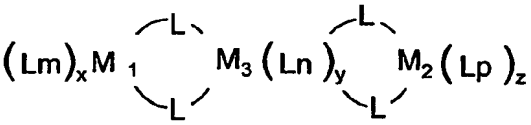
where L is a bridging ligand and where M_1 is a rare earth metal and M_2 is M_1 or a non rare earth metal, Lm and Ln are the same or different organic ligands Lα as defined above, x is the valence state of M_1 and y is the valence state of M_2 or



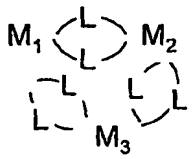
or



where M_1, is a rare earth metal and M_2 and M_3 are M_1 or a non rare earth metal; Lm, Ln and Lp are organic ligands Lα and x is the valence state of M_1, y is the valence state of M_2 and z is the valence state of M_3 and Lp can be the same as Lm and Ln or different or



or



where L is a bridging ligand and in which the rare earth metals and the non rare earth metals can be joined together by a metal to metal bond and/or via an intermediate bridging atom, ligand or molecular group or in which there are more than three metals joined by metal to metal bonds and/or via intermediate ligands

6. An electroluminescent device as claimed in any one of claims 3 to 5 in which the metal M_2 is any metal which is not a rare earth, transition metal, lanthanide or an actinide.

7. An electroluminescent device as claimed in any one of claims 3 to 6 in which the metal M_2 is selected from lithium, sodium, potassium, rubidium, caesium, beryllium, magnesium, calcium, strontium, barium, copper (I), copper (II), silver, gold, zinc, cadmium, boron, aluminium, gallium, indium, germanium, tin (II), tin (IV), antimony (II), antimony (IV), lead (II), lead (IV) and metals of the first, second and third groups of transition metals in different valence states e.g. manganese, iron, ruthenium, osmium, cobalt, nickel, palladium(II), palladium(IV), platinum(II), platinum(IV), cadmium, chromium. titanium, vanadium, zirconium, tantulum, molybdenum, rhodium, iridium, titanium, niobium, scandium and yttrium.

8. An electroluminescent device as claimed in any preceding claim, in which there is an organic hole transporting material in contact with the layer of light emitting material.

9. An electroluminescent device as claimed in claim 8 in which the hole transmitting material is a film of a polymer selected from poly(vinylcarbazole), N,N'-diphenyl-N,N'-bis (3-methylphenyl) -1,1' -biphenyl -4,4'-diamine (TPD), polyaniline,

substituted polyanilines, polythiophenes, substituted polythiophenes, polysilanes and substituted polysilanes.

10. An electroluminescent device as claimed in claim 8 or 9 in which the hole transmitting material is a film of a compound of formula (II) or (III) herein or as in Figure 11, 12, 13, or 14 of the drawings.

11. An electroluminescent device as claimed in any one of claims 1 to 10 in which there is a layer of an electron transmitting material between the cathode and the electroluminescent material layer.

12. An electroluminescent device as claimed in claim 11 in which an electron transmitting material and the light emitting metal compound are mixed to form one layer.

13. An electroluminescent device as claimed in claim 11 or 12 in which the electron transmitting material is a metal quinolate.

14. An electroluminescent device as claimed in claim 13 in which the metal quinolate is an aluminium quinolate or lithium quinolate

15. An electroluminescent device as claimed in claim 11 or 12 in which the electron transmitting material is selected from cyanoanthracenes such as 9,10 dicyanoanthracenes, polystyrene sulphonates or a compound of formulae shown in Fig. 10.

16. An electroluminescent device as claimed in any one of claims 8 to 15 in which a hole transmitting material and an electron transmitting material and the light emitting metal compound are mixed to form one layer.

17. An electroluminescent device as claimed in any one of the preceding claims in which the second electrode is selected from aluminium, calcium, lithium, silver/magnesium alloys

18. An electroluminescent device as claimed in any one the preceding claims in which the fluorescent dye has a bandgap no greater than that of the electroluminescent material and a reduction potential less negative than that of the electroluminescent material.

19. An electroluminescent device as claimed in any one the preceding claims in which the fluorescent dye is chosen from the class consisting of coumarin, dicyanomethylenepyrans and thiopyrans, polymethine, oxabenzanthracene, xanthene, pyrylium and thiapyrylium, carbostyril, and perylene fluorescent dyes.

20. An electroluminescent device as claimed in any one of in any one the preceding claims in which the electroluminescent material is capable of emitting light of a first wavelength in the absence of said fluorescent material and said fluorescent material is capable of absorbing light at the first wavelength.

21. An electroluminescent device according to claim 20 in which the wavelength of maximum light emitted by said host material in the absence of said fluorescent material is within 25 nm of the wavelength of maximum light absorption by said fluorescent material.

22. An electroluminescent device as claimed in any one of in any one the preceding claims in which the fluorescent dye is a blue emitting dye.

23. An electroluminescent device as claimed in any one of in any one the preceding claims in which the fluorescent dye exhibits a shorter wavelength emission peak than the electroluminescent material

24. An electroluminescent device as claimed in claim 23 in which the blue emitting fluorescent dye contains a stabilizing aromatic chromophoric unit containing at least 5 fused carbocyclic aromatic rings.

25. An electroluminescent device as claimed in claim 23 in which the chromophoric unit contains from 20 to 40 ring carbon atoms.

26. An electroluminescent device as claimed in claim 24 or 25 in which the fluorescent dye chromophoric unit is chosen from among those containing a perylene, benzopyrene, benzochrysene, benzonaphthacene, picene, pentaphene, pentacene, hexacene or anthanthrene nucleus.

27. An electroluminescent device as claimed in any one the preceding claims in which the fluorescent dye is present in a concentration ranging from 0.05 to 5 mole percent.

28. An electroluminescent device as claimed in any one the preceding claims in which the fluorescent dye is present in a concentration ranging from 0.2 to 3 mole percent.